JAPAN

EDICT OF GOVERNMENT

JIS B 9706-3 (2009) (English): Safety of machinery -- Indication, marking and actuation -- Part 3: Requirements for the location and operation of actuators

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The citizens of a nation must honor the laws of the land.

Fukuzawa Yukichi

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(JMF)

Safety of machinery—Indication, marking and actuation—Part 3: Requirements for the location and operation of actuators

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In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

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Contents

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Health, Labour and Welfare, and the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Machinery Federation (JMF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS B 9706-3** : 2001 is replaced with this Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Ministers and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

JIS B 9706 consists of the following three parts under the general title "*Safety of machinery—Indication, marking and actuation*"

Part 1: Requirements for visual, acoustic and tactile signals

Part 2: Requirements for marking

Part 3: Requirements for the location and operation of actuators

Safety of machinery—Indication, marking and actuation—Part 3: Requirements for the location and operation of actuators

Introduction

This Japanese Industrial Standard has been prepared based on the second edition of **IEC 61310-3** published in 2007 without any modifications of the technical contents.

The portions underlined with dots are the matters not given in the corresponding International Standard.

1 Scope

This Standard specifies safety-related requirements for actuators, operated by the hand or by other parts of the human body, at the human-machine interface.

It gives general requirements for

— the standard direction of movement for actuators;

— the arrangement of an actuator in relation to other actuators;

— the correlation between an action and its final effects.

It is based on **JIS C 0447** but is also applicable to non-electrotechnical technologies such as mechanical and fluid-powered systems.

It covers single actuators as well as groups of actuators forming part of an assembly.

This Standard does not specify any requirements for "touch screens" (such information is given in **JIS C 0447**).

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows:

IEC 61310-3 : 2007 *Safety of machinery—Indication, marking and actuation—Part 3: Requirements for the location and operation of actuators* (IDT)

The symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall apply but the revisions (including amendments) made thereafter shall not apply. The normative reference without the indication of the year shall apply only to the most recent edition (including amendments).

JIS B 9706-1 : 2009 *Safety of machinery—Indication, marking and actuation—Part 1: Requirements for visual, acoustic and tactile signals*

NOTE : Corresponding International Standard: IEC 61310-1 : 2007 *Safety of machinery—Indication, marking and actuation—Part 1: Requirements for visual, acoustic and tactile signals* (IDT)

JIS B 9706-2 : 2009 *Safety of machinery—Indication, marking and actuation—Part 2: Requirements for marking*

NOTE : Corresponding International Standard: IEC 61310-2 : 2007 *Safety of machinery—Indication, marking and actuation—Part 2: Requirements for marking* (IDT)

JIS B 9712 : 2006 *Safety of machinery—Two-hand control devices—Functional aspects and design principles*

NOTE : Corresponding International Standard: ISO 13851 : 2002 *Safety of machinery—Two-hand control devices—Functional aspects and design principles* (IDT)

JIS C 0447 *Man-machine interface (MMI)—Actuating principles*

NOTE : Corresponding International Standard: IEC 60447 *Basic and safety principles for man-machine interface, marking and identification—Actuating principles* (IDT)

JIS Z 8907 : 1987 *Geometrical orientation and directions of movements*

NOTE : Corresponding International Standard: ISO 1503 : 1977 *Geometrical orientation and directions of movements* (MOD)

ISO 9355-2 : 1999 *Ergonomic requirements for the design of displays and control actuators—Part 2: Displays*

IEC 60073 : 2002 *Basic and safety principles for man-machine interface, marking and identification—Coding principles for indicators and actuators*

3 Terms and definitions

For the purposes of this document, the following terms and definitions, as well as those of **JIS B 9706-1** and **JIS B 9706-2**, apply.

3.1 action

movement required of a part of the human body (for example, a finger, a hand, a foot) to operate an actuator

3.2 final effect

intended consequence of the operator's action

4 General requirements

This Standard shall be taken into account at an early stage of machinery design and shall be applied in an unambiguous manner throughout the machine installation. The intended application field of the machine and the constraints due to the geometrical orientation of the machine, the location, skill, posture and the viewing direction of the operator (see **4.2.2** of **JIS B 9706-1**) shall be taken into account. See also **JIS B 8907**.

Actuators shall be

— unambiguously identifiable (see **JIS B 9706-1** and **IEC 60073**);

— appropriately marked (see **JIS B 9706-2**);

— designed to ensure safe and timely operation (see **JIS C 0447**);

— selected and designed in accordance with the relevant ergonomic principles (see **ISO 9355-2**);

— designed and selected to withstand the expected environmental and intended use conditions;

— designed to be able to avoid wear and tear by foreseeable use.

Actuators shall be so located that

— they are outside the hazard zones, except for those actuators which, of necessity, are located within the hazard zone, such as emergency stop, teach pendant, etc.

— their operation cannot cause additional risk;

— the operator can recognize that the final effect has been carried out (either directly or by a feedback/acknowledgement device);

— the movement of the actuator is consistent with its final effect in accordance with clause **5** (for additional information see **JIS C 0447**);

— mirror symmetric layouts of panels are avoided.

Wherever possible, start actuators shall be so located that the operator can see the controlled elements when actuating them [see **4.11.8 d**) of **JIS B 9700-2**].

A stop actuator shall be placed near each start actuator. Where the start/stop function is performed by means of a hold-to-run actuating device[1)], a separate stop actuator shall be provided where a hazard may result from the hold-to-run actuating device failing to deliver a stop command when released.

Note [1)] "Hold-to-run control device" is a control device which initiates and maintains hazardous machine functions only as long as the manual control (actuator) is actuated (see **JIS B 9700-1**, **3.26.3**).

Actuators shall be logically grouped in accordance with their operational or functional correlation, for controlling a process, machine or equipment (see **JIS C 0447**).

Actuators shall not lead to an undefined or hazardous state of equipment, or condition of process, when operated.

The accidental operation of an actuator which could lead to a hazardous situation shall be avoided, as far as possible. One or more of the following constructive measures shall be used where necessary:

— recessing or shrouding the actuator;

— increasing the operating force of the actuator;

— use of a lock-out system;

— locating the actuator where it is unlikely to be accidentally knocked;

— using a set of actuators requiring sequential actions;

— using a two-hand control system (see **JIS B 9712**);

— using an enabling device[2)];

— remote disabling of function.

Note [2)] "Enabling device" is an additional manually operated device used in conjunction with a start control and which, when continuously actuated, allows a machine to function (see **JIS B 9700-1**, **3.26.2**).

Where the action is initiated indirectly (for example, use of keyboards), the action to be performed shall be clearly displayed and an unambiguous confirmation (visual or audible feedback) of the actuation shall be given to the operator.

Where the operator's vision may be fully occupied when safety-critical functions are involved, or where the conditions of visibility are restricted, the position of an actuator shall be readily identifiable by touch. (For details of tactile signals, see **JIS B 9706-1**.)

5 Actions and effects

NOTE : This Standard is based on **JIS C 0447**. For additional information on ergonomic design of displays and actuators, see **ISO 9355-2**.

5.1 Principles

For a machine, the correlation between the action applied to the actuator and the final effect shall be evident to the operator. This correlation is based on the classification into two groups of both actions and final effects.

Intermediate effects which lead to a final effect are not considered in this Standard.

NOTE : As an example, for a variable speed drive, the final effect is the operating speed which results from the action, and not the output-command of a data processing unit, nor the variation of the field regulator.

5.2 Final effects

Final effects resulting from actions can mostly be classified into two groups of opposite effects.

For a final effect which cannot be classified as increase/decrease effects such as test, help, enabling device, the arrangement of these actuators should nevertheless conform to clause **4**.

Table 1 (derived from table A.2 of **JIS C 0447**) shows how different types of effects can be classified into two groups.

Table 1 Classification of final effects

Nature of effect	Resulting final effect	
	Group 1	Group 2
Modification of a physical quantity (voltage, current, power, speed, frequency, temperature, luminous intensity, etc.)	Increase	Decrease
Change of condition	Put into service Start Accelerate Close an electrical circuit [a)] Ignite	Put out of service Stop Brake Open an electrical circuit [b)] Extinguish
Motion of the object or vehicle controlled in relation to its principal axis	Upwards To the right Forward	Downwards To the left Backward
Motion in relation to the operator	Away from the operator	Towards the operator
Notes [a)] and open the associated grounding circuit, if combined. [b)] and close the associated grounding circuit, if combined.		

5.3 Actions

Actions can also be classified into two groups based on

— either the direction of movement of an actuator, where the actuator has two operating directions. Action is then a related movement of a part of the human body;

— or the positioning of a given actuator within a set where the actuators have only one operating direction giving rise to only one final effect. This action is then a movement of a part of the human body towards the given actuator.

The classification into Group 1 and Group 2 (see table 2) depending on the nature of an action is based on

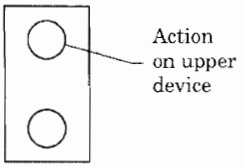
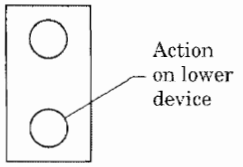
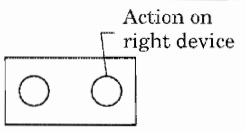
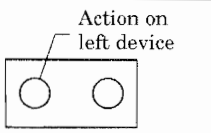
— either the direction of the action;

— or the point of application of the action.

Table 2 (identical to table A.1 of **JIS C 0447**) shows how an action associated with different types and arrangements of actuators can be classified, and Annex A (identical to Annex B of **JIS C 0447**) gives examples of monofunction actuators.

Table 2 Classification of actions

Nature of actuator	Nature of action		Direction of action	
			Group 1	Group 2
Handwheel, handle, knob, etc.	Rotation		Clockwise 	Anticlockwise 
Grip, lever, push-pull button, etc., with essentially linear motion [a]	Vertical motion		Upwards 	Downwards 
	Horizontal motion	Right-left	To the right	To the left
		Forward-backward [a]	Away from the operator 	Towards the operator 
Note [a] Further information is given in **JIS C 0447**.				

Nature of actuator set		Nature of action	Point of application of action	
			Group 1	Group 2
Set of grips, push-buttons, rods, pull cords, etc., with opposite effects	One above the other	Pressure, traction, etc.		
	One beside the other			

Nature of actuator set	Nature of action	Classification of action
VDT with XY-VDU Controller	Movement and actuation (click)	Direction of action and point of application: not classified [b]
Keyboard	Typing of keys	
Sensitive area	Touching	
Note [b] As far as possible, the rules of the upper part of table 2 should be applied.		

5.4 Correlation between actions and final effects

A Group 1 action shall result in a Group 1 final effect.

A Group 2 action shall result in a Group 2 final effect.

Examples a) A clockwise rotation of a handwheel results in an increased speed.

b) A movement of a lever to the left results in a motion of an object to the left.

c) The movement of the actuating hand is in the same direction as the intended movement of a controlled object.

Where the relative position of the operator and the machine can change (especially in the case of a mobile machine and/or a portable set of actuators for remote control), the directions of movement of the machine can become ambiguous. Then suitable marks, corresponding to the symbols and/or colours on or near the actuator, shall be affixed on or near the mobile part of the machine.

Where, for special reasons (see NOTES 1 and 2), established current practice is not in line with this principle:

— the direction of movement of the part of the human body and the resulting final effect shall be given on or near the actuator;

— the change to bring this practice into conformity should be achieved by changing the type of actuator used (for example, from lever to push-button). Where a change in the type of actuator is not suitable, the operator shall be specially instructed.

NOTE 1 Such special reasons may include those cases where there already exist well-established expectations by the operators of the way particular actuators should function. Special reasons also include cases where it is technically difficult to maintain the correlation between the action and the effect. For example, valves for fluid control are normally arranged so that turning them clockwise reduces the flow.

NOTE 2 See **JIS C 0447** for requirements for special kinds and particular uses of actuators, such as:

— raise and lower with a lever;

— push-pull buttons;

— foot-operated actuators.

5.5 Stopping

With many types of actuators a specific position gives the effect of stop. The location of this position shall be as follows.

a) For an actuator controlling one linear or one angular movement away from a stop, the stop-position shall be at the left end, at the lower end, or at the anti-clockwise end, of the movement.

b) For an actuator controlling two opposite linear or angular movements away from a stop, the stop-position shall be in the middle of the range of movements.

For a set of actuators, each giving one final effect with the same operating direction, the stop actuator shall be placed at the left end, or at the lower end, of the set.

Where the set of actuators causes opposite effects, the stop actuator shall be placed in the middle of the set.

NOTE : For requirements for emergency stop actuators, see **JIS B 9960-1**, **IEC 60947-5-5** and **JIS B 9703**.

Annex A (informative)
Typical examples of monofunction actuators

Introduction

This Annex is to show examples of direction of action of monofunction actuators and not to constitute the provisions of this Standard. This Annex is virtually identical with Annex B of **JIS C 0447**.

A.1 Kinds of actuators

A.1.1 General

In table A.1, typical examples of actuators are shown, an arrow in each figure showing the classified action which results in the final effect (in accordance with table 2).

The operating direction is determined by a person standing at the operating place and looking towards the actuator. The operating place in each of the figures of the table is indicated by the position of the figure number.

A.1.2 Rotation

If a rotating handle is combined with an angular indicator, the movement is always considered as a rotation (see example 15 in table A.1).

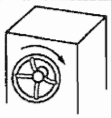
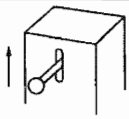
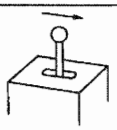
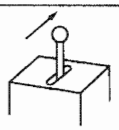
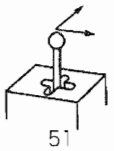
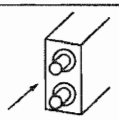
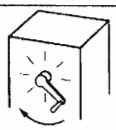
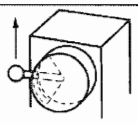
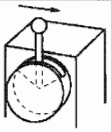
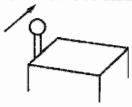
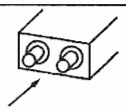
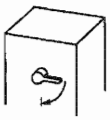
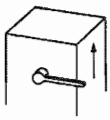
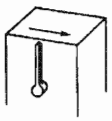
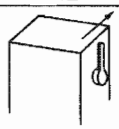
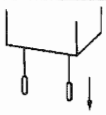
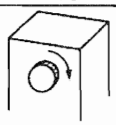
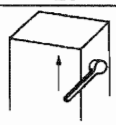
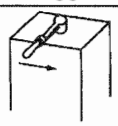
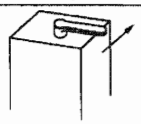
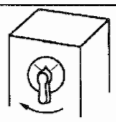
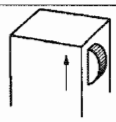
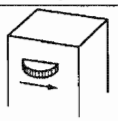
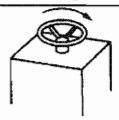
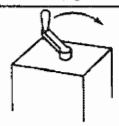
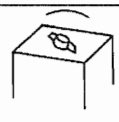
A movement from one of the three principal axes to another, as shown in example 13 in table A.1, is considered as a rotation.

A.1.3 Linear motion

Linear motion is considered to be a movement practically parallel to a principal axis, i.e. equally distributed on both sides of another axis, where the total permissible angular movement does not exceed 120°, (see examples 22, 23, 24, 32, 33, 34, 42, 43 and 44 in table A.1).

Where the angular displacement is small (examples 21, 31, 41 and 51 in table A.1), or where only a small part of the periphery of a rotating actuator is accessible or visible, such as a handwheel situated partly in an enclosure, or a knob recessed behind a slot (examples 25 and 35), the actuator should be considered to have a linear motion.

Table A.1 Examples of movement of some types of actuators

Movement [a]					
Angular (rotary)	Linear [b]				Set of actuators
	Vertical	Horizontal: Sideways	Horizontal: Fore and aft	Combined directions	
 11	 21	 31	 41	 51	 61
 12	 22	 32	 42		 62
 13	 23	 33	 43		 63
 14	 24	 34	 44		
 15	 25	 35			
 16					
 17					
 18					

Notes [a] In each case, the operator is considered to be in the place of the figure number, and the arrow relates to a Group 1 action in table 2.

[b] In certain circumstances, an angular (rotary) movement is considered to be linear.

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